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Patent Claims

1. A method for operating a compression-ignition internal combustion engine having a cylinder, in which a combustion chamber is delimited between a piston and a cylinder head, an engine control device, an intake valve, an exhaust valve, a fuel feed device and a downstream exhaust gas aftertreatment system, in which

- combustion air is fed to the combustion chamber via the intake valve,
- a quantity of fuel is metered in as a function of the operating point during a working cycle,

characterized in that

- a mean gas temperature in the cylinder is determined during a combustion operation in the combustion chamber,
- so that a gradient of the mean gas temperature is calculated, and
- the untreated nitrogen oxide emission level from the internal combustion engine is determined from a value for the gradient of the mean gas temperature and/or from a position of the gradient of the mean gas temperature in the combustion chamber.

2. A method for operating a compression-ignition internal combustion engine having a cylinder, in which a combustion chamber is delimited between a piston and a cylinder head, an engine control device, an intake valve, an exhaust valve, a fuel feed device and a downstream exhaust gas aftertreatment system, in which

- combustion air is fed to the combustion chamber via the intake valve,
- a quantity of fuel is metered in as a function of the operating point during a working cycle,

characterized in that

- a mean gas temperature in the cylinder is determined during a combustion operation in the combustion chamber,
- so that the untreated nitrogen oxide emission level from the internal combustion engine is determined from a maximum value for the mean gas temperature in the combustion chamber and/or from a position of the maximum value for the mean gas temperature.

3. A method for operating a compression-ignition internal combustion engine having a cylinder, in which a combustion chamber is delimited between a piston and a cylinder head, an engine control device, an intake valve, an exhaust valve, a fuel feed device and a downstream exhaust gas aftertreatment system, in which

- combustion air is fed to the combustion chamber via the intake valve,
- a quantity of fuel is metered in as a function of the operating point during a working cycle,

characterized in that

- a mean gas temperature in the cylinder is determined in the combustion chamber,
- the untreated nitrogen oxide emission level from the internal combustion engine is determined from a value for a mean gas temperature when the intake valve is closed and/or a value for a final compression temperature in the combustion chamber.

4. The method as claimed in one of claims 1 to 3, characterized in that the mean gas temperature is determined in a defined crank angle range.

5. The method as claimed in one of claims 1 to 4, characterized in that a quantity of a reducing agent for the downstream exhaust gas aftertreatment system is determined from the untreated nitrogen oxide emission

level which has been determined.

6. The method as claimed in one of claims 1 to 5, characterized in that the metered quantity of fuel is injected into the combustion chamber in such a manner that a predetermined gradient of the mean gas temperature in the combustion chamber and/or a predetermined position of the maximum value for the mean gas temperature is established in the combustion chamber.

7. The method as claimed in one of claims 1 to 5, characterized in that the metered quantity of fuel is injected into the combustion chamber in such a manner that a combustion center of gravity is at a defined crank angle position.

8. The method as claimed in one of claims 1 to 7, characterized in that an exhaust gas recirculation quantity for setting a defined oxygen concentration in the combustion chamber is set as a function of a combustion center of gravity.

9. The method as claimed in one of claims 1 to 8, characterized in that a drop in the oxygen concentration which is required for nitrogen oxide reduction is calculated from the calculated untreated nitrogen oxide emission level, so that an exhaust gas recirculation device is set in such a manner that after combustion air has been mixed with recirculated exhaust gas a defined oxygen concentration is produced in a cylinder charge upstream of or in the combustion chamber.

10. The method as claimed in one of claims 1 to 9, characterized in that the oxygen concentration of the combustion air before it enters the combustion chamber is measured by means of an oxygen sensor, and a defined

oxygen concentration of the combustion air upstream of or in the combustion chamber is set by means of the exhaust gas recirculation device as a function of the measured concentration.

11. The method as claimed in one of claims 1 to 9, characterized in that the oxygen concentration of the exhaust gases after the exhaust gases have emerged from the combustion chamber is measured by means of an oxygen sensor, and the oxygen concentration of the combustion air before it enters the combustion chamber is calculated from this signal, an exhaust gas recirculation rate and a measured combustion air quantity, and a defined oxygen concentration of the combustion air upstream of or in the combustion chamber is set by means of the exhaust gas recirculation device as a function of the calculated concentration.